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Fuel Oil (Bunker) Blending
An Overview

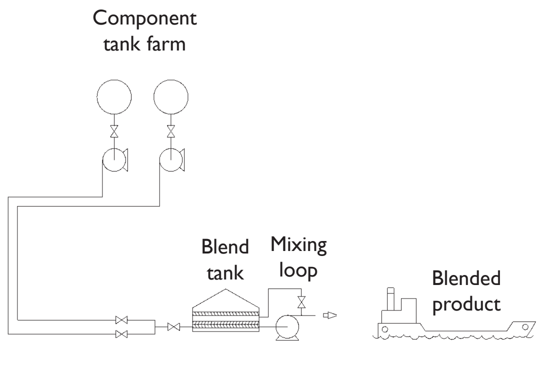
Jiskoot Ltd. 1998

The blending of heavy fuel oil (HFO) with gas oil or marine diesel oil (MDO) to produce a range of intermediate fuel oils of specified viscosity for marine bunkers is one of the major skills of the bunker supplier. The ability to accurately blend to a pre-determined viscosity and deliver precise metered volumes can provide an operator with a competitive edge in this very commercial market.

Blending is not new to the bunker industry; indeed batch blending in one form or another has been practised for several decades. There are two fundamental forms of blending; batch/sparge and in-line.

Batch Blending

This takes one of two main forms. In both cases the two base components HFO and MDO are added together sequentially into a tank that is then mechanically mixed to provide a homogenous product. The difference in sparge blending is that the blend in the tank is recycled. The oil re-enters the tank via a sloping tube with holes cut in it to enhance the dispersion effect. This method improves total homogenisation of the fuel and allows representative samples to be taken from the recycle pipework for analysis.



Typical batchblending system

The drawback with both these methods is the time delay to fully mix the components. On occasions this can sometimes take as long as 1 hour. After this a sample frequently has to be extracted and taken for analysis which incurs a further delay. In addition batch blending is only really practical as a shore based system. The bunkering barge therefore can only carry pre-blended grades of fuel; although sparge mixing can be performed on the bunkering barge. The accuracy of the blend is totally reliant on the accuracy to specification of both base oils, and the equipment performing the sequential metering. In some cases the volumes to be added are calculated by tank level of the base oils. Batch blending however is still a viable method where market demand is small and /or intermittent.

In-line Blending

By definition, in-line blending is "the continuous proportioning of two or more components in order to produce a final product of closely defined quality".

In the early days this was performed using a mechanical blender to ratio two streams. Its basic operation was very simple and utilised two valves (one for each component), sharing a common diaphragm actuator.

One valve was opened the second valve was proportionally closed, thus achieving the ratio between the components. Adjustment of the ratio was by means of a handwheel on the metering valve.

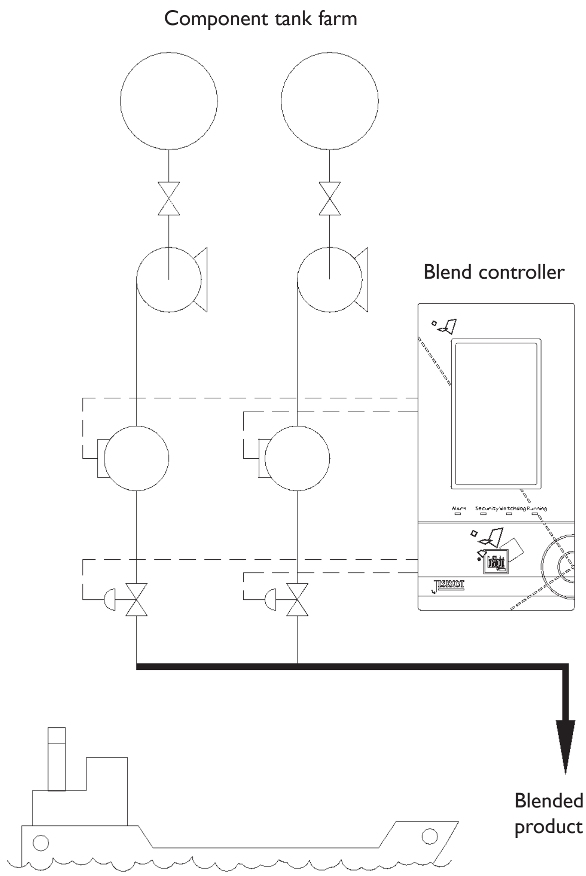
However because of the competitiveness of the bunkering market and the need for tighter specification, there are strong indications that the trend is now moving towards in-line blenders controlled by microprocessor based blend controllers.

The basic principle of operation of these blenders is that the flow in each component line is measured by means of a flowmeter, and controlled (regulated) by means of either a control valve, or by varying the output from a positive displacement pump. The meter may be a positive displacement type fitted with a pulse transmitter, vortex or "coriolis" mass meter. The control system generates the demand flowrate for each component stream. This is fed to the PID algorithm of each stream as a set point and compared to the measured flow from the stream flowmeter. Any deviation between the set point and the measured flowrate is stored in memory and an appropriate adjustment is made automatically to the control valve in that stream. Thus opening or closing the valve to increase or decrease the component flow to bring this back to the required stream flowrate.

If there is starvation of flow in the metering stream, the control valve will open to compensate. However if it reaches a point at which it can no longer properly control, a cut-back (pacing) signal is sent to the control system to reduce the master demand rate to equal the maximum flowrate at which the lagging component can maintain correct ratio and accuracy. Most blending systems, particularly those in the petrochemical industries, operate this way and produce very good results. This type of system also lends itself to skid or trailer mounting, enabling it to be towed around a harbour/terminal or mounted on the deck of a bunkering barge.

The use of microprocessor based controllers enables several advanced features and facilities to be provided. For example a number of predetermined recipes can be stored, the operator then only calls up a recipe by name or number and the controller sets correct ratios. Temperature compensation can be performed electronically using the signal from a resistance bulb or temperature transmitter to correct measured volumes to a base temperature. The blend controllers also provide the facility to drive a printer to and communicate with another computer system over an RS232 or 422 serial link using Allen Bradley or Modicon Modbus protocols.

As the systems are digital and closed-loop, the accuracy of the electronics should be ± 1 pulse for the flow signal, and analogue conversion for temperature is



Typical in-line blending system

around 1 part in 8000 for the 4-20mA range. The control system accuracy therefore is as good as the accuracy of the field equipment. The accuracy of the whole system will depend entirely on the accuracy of the flow meter used.

This means, therefore, that you can volumetrically blend components to within ± 0.5% of instantaneous flow rate. Alternatively blending can be performed on a mass basis. It follows that if one knows the quality parameters of the base components, one can produce a very good final product within very close quality parameters.

Analyser Feedback and Trim

There are occasions were the quality of the base components of a blend may vary and yet it is still required to produce a final product to close viscosity tolerances. The solution is quite simple really, a density or viscosity analyser can be installed in the final blend header and the analyser signal allowed a limited freedom to reset the volumetric ratio setting. It is usual to allow only a small drift in quality adjustment before raising an alarm, thus preventing the analyser controls from trying to trim for an incorrect base oil. This practice of "analyser feedback" is now a regular occurrence in many multi-stream applications.

In-line blending has several important advantages, both technical and economic, over the more traditional batch blending techniques.

- **Reduction in production time**

  No in tank mixing required

- **Reduction in give-away**

  Higher blend accuracy and continuous metering of all streams provides better quality control and less wastage of expensive components. Savings can be achieved even with a relatively low annual throughput.

- **Improvement in quality**

  Volumetric accuracy's of < + 0.5% can be easily obtained with in-line blenders, and the incorporation of an output analyser trim guarantees that the final product is of a highly uniform quality.

- **Improved production flexibility**

  Changes in schedules and clients' requirements can be accommodated simply by the selection of a different recipe from the controller. The supplier can provide a wide range of products in varying batch sizes from two base stocks.

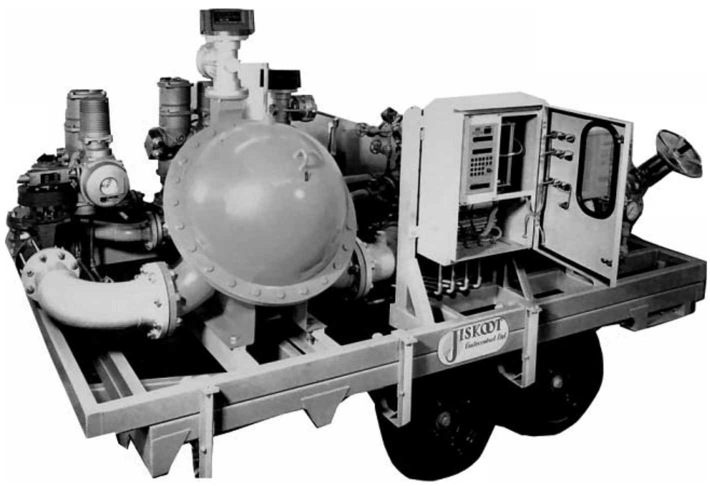
- **Reduced operating cost**

  Once the blender has been started the process is self supervisory, and can produce the final product and billing, totally unsupervised, only informing an operator if an alarm condition occurs.

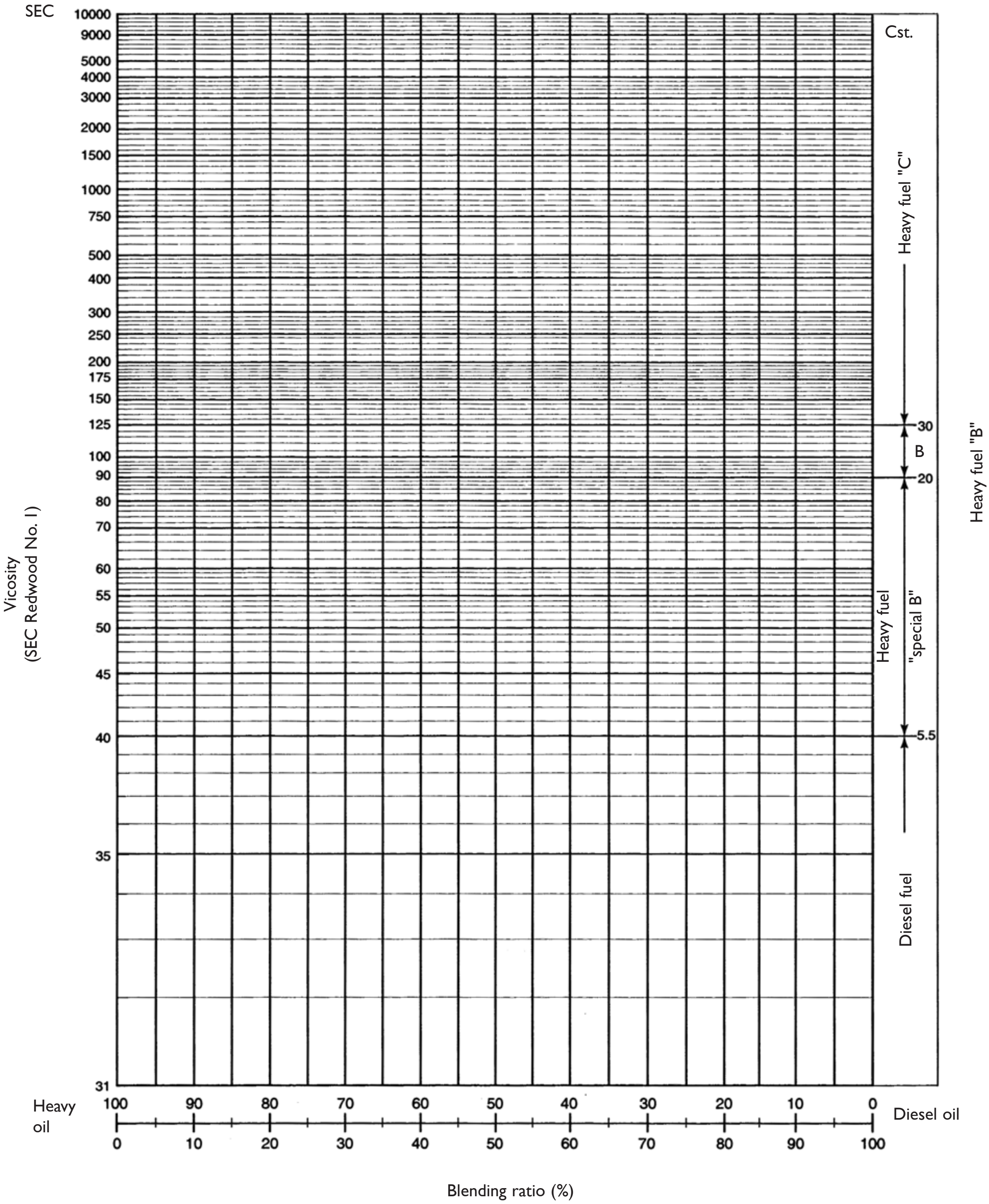
- **Reduced Tankage requirements**

  There is no need to hold any stocks of blended product.(capital lockup), as the In-line blender produces the final product almost simultaneously.

Typical mobile blenders



Blending chart



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